



ADEUNIS RF AND ADEUNIS-NA, INC.

GN Docket Nos. 14-166 & 12-268

April 21, 2015

WIRELESS PRODUCTS & SOLUTIONS

- Founded in 1993, Adeunis RF is a French corporation engaged in the design, manufacture and marketing of wireless communications systems.
- It operates in the United States through its wholly owned subsidiary, Adeunis-NA, Inc. Adeunis' products operate under rules promulgated by the FCC, EU and other regulatory bodies around the world.
- Adeunis offers its customers products and services in four evenly balanced market ranges:
 - Radio transmission modules designed for incorporation into conventional electronic equipment.
 - Finished products ("off the shelf" products, also called "ready to use" solutions), tested, packaged and certified for pairing with customer solutions.
 - Wireless, hands-free, multiuser audio conference systems with noise filtering and no fixed base unit.
 - Metering solutions such as RF W-Mbus Counters, repeaters and gateways for electricity, gas, water and heating system markets.



Adeunis Proposals in this Proceeding

- Allocate additional radio spectrum for wireless microphones, both licensed and unlicensed;
- Require unlicensed wireless microphone users of the same frequency band, in the same general location, at the same time, to coordinate frequency use among themselves;
- Require the use of spectrum emission masks, as appropriate, by wireless microphones;
- Adopt a 500 kHz channel limit, rather than a 200 kHz limit;
- Include modulation bandwidth requirements in the rules;
- Allow wireless microphone users to operate as Low Power Auxiliary Stations (“LPAS”) under the auspices of an operator of a large venue’s Part 74 license, without further FCC approval;
- Increase the size of the 944-952 MHz band, by adding the 941-944 and 952-960 MHz frequencies thereto; and
- Define transient requirements for spread spectrum operation in the 902-928 MHz band, along with a bar against the operation of base stations with synchronization of multiple “hopping” systems, and in the inclusion of an appropriate duty cycle limit.

Vokkero : Technical Characteristics

Vokkero: two separate products to answer US market needs. Greater product availability means more customer choices, better quality & lower prices.

VOKKERO SQUADRA®



VOKKERO EVO3®





Main Parameters (Glossary on slide 18)

Parameter	Vokkero SQUADRA	Vokkero EV03
Frequency Band	Unlicensed 902-928MHz	
Datarate	163.2 kbps	76.8 kbps
Modulation	2 GFSK +/-70 kHz	2 GFSK +/-30 kHz
Hopping	Yes, according FCC sec. 15.247	
TDMA	30 ms cycle with repetition (15 ms+15 ms)	30 ms cycle
Radiated power	Up to 24 dBm (250 mW)	
Number of Hopping Channels	≥25	
FCC Identifier	U3Z-ARF7822	U3Z-ARF7672

- **In the US 902-928 MHz unlicensed band** (FCC sec. 15.247)
 - No stringent requirements for modulation bandwidth for FHSS transmitter. For example , for a 25 channels hopping system, 20dB bandwidth must be **higher than 250 kHz** and lower than 500 kHz without regard to the RF data rate.
 - No duty cycle limitation.
 - No requirements regarding transient power of the transmitter. Transient power = out of channel emissions.
 - when switching from Std by (Or Rx) mode to Tx mode.
 - when switching from Tx-FHn channel to Tx-FHm channel (from the hopping sequence).
- **The consequences are :**
 - Difficulties sharing the spectrum in the same location.
 - Reduction of quality of service for users.
 - Fewer user choices of equipment.
- **Small additional requirements could help to improve quality of service.**
 - Next slides show the differences between a classical hopping system & a Vokkero system.
 - No significant additional cost to implement; software modifications will be sufficient most of the time.

902-928MHz - Modulation bandwidth

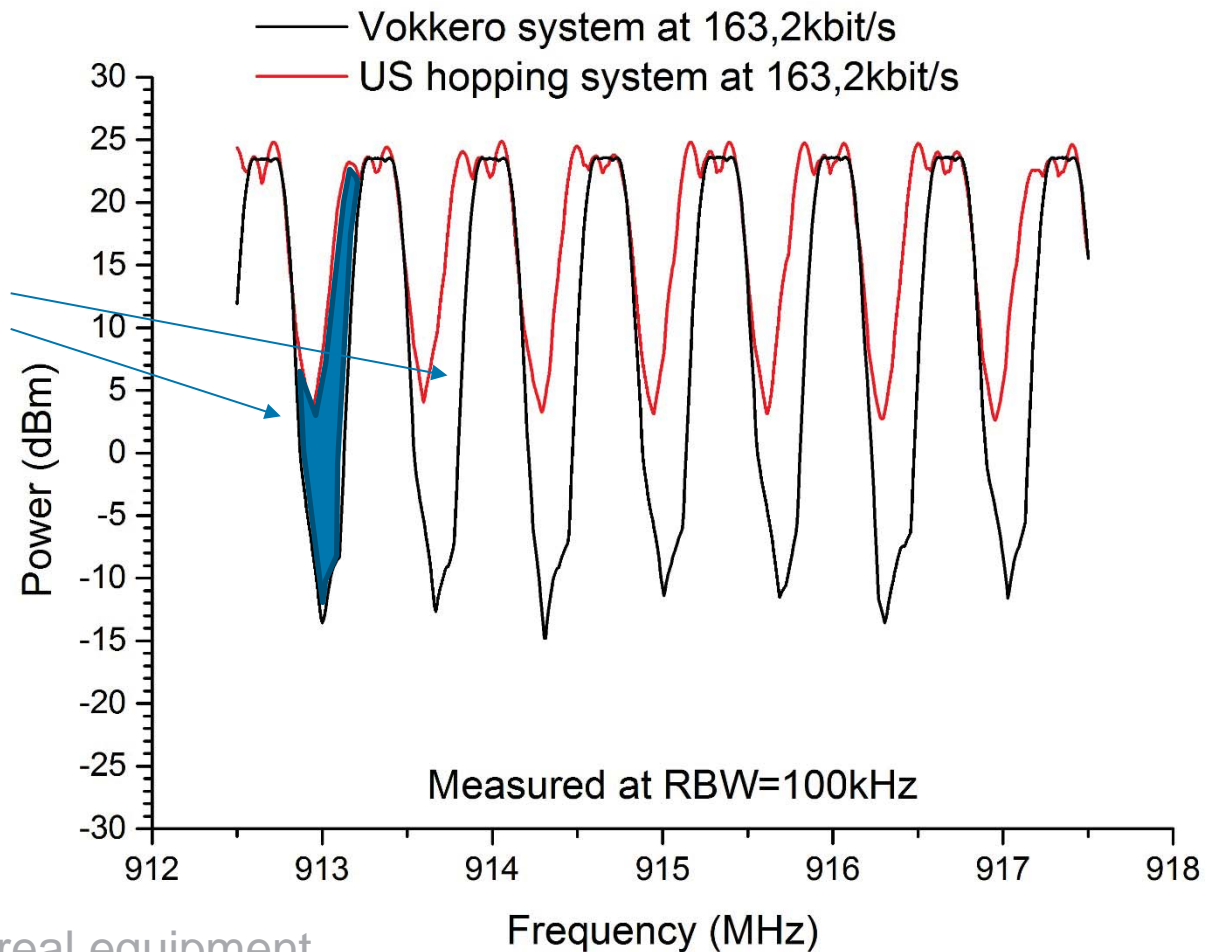
At the same RF data rate,
it's possible to reduce
modulation bandwidth.

Between 20 & 40 dB gain
in the blue areas (Out of
Channel Emissions)

Simply need to suppress
the minimum modulation
bandwidth of 250 kHz

Only software
modification needed.

More users sharing the
same band.



Measurements made on real equipment

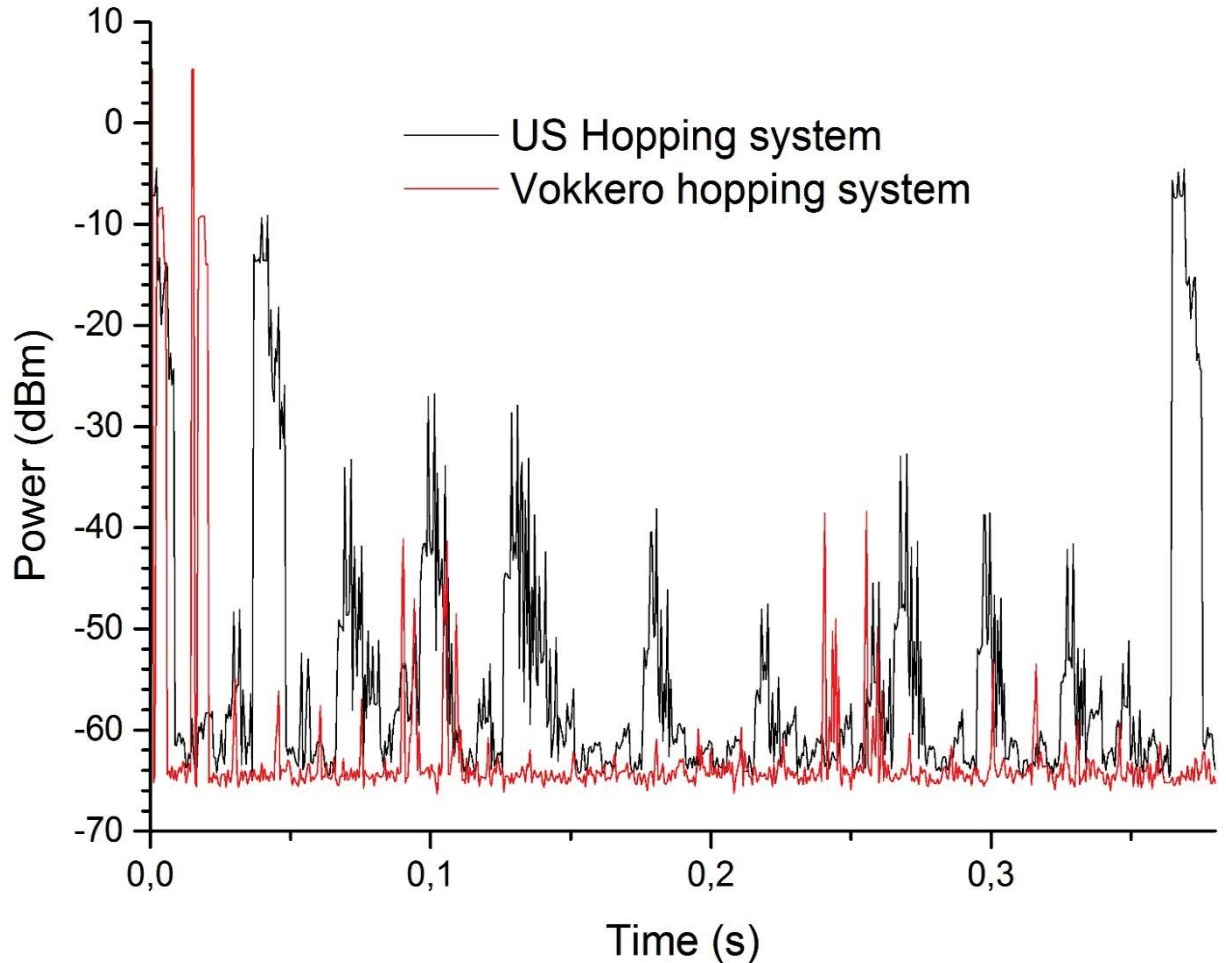
902-928MHz - Transient power

Only with PA ramp up & down function (only software), the spurious out of the channel conditions occur less with a Vokkero system than for a classical US Hopping system

At any time and on any channel (100 kHz bandwidth), there are high risks of interference with a classical US hopping system (Black curve) and less with a Vokkero (Red curve)

No additional cost & a better quality of service for user.

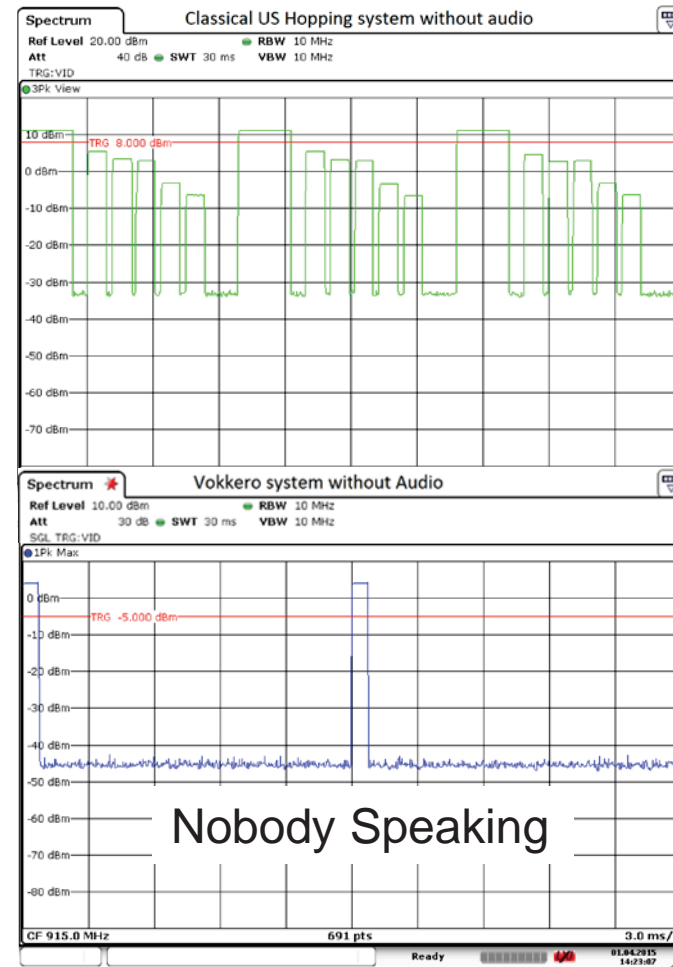
Measurements made on real equipment



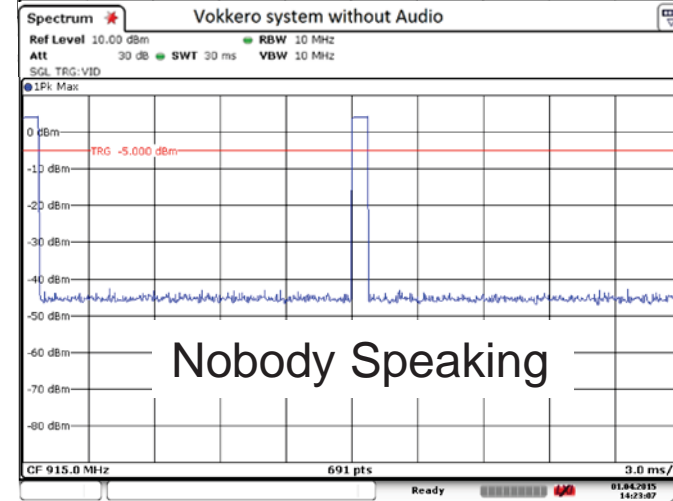
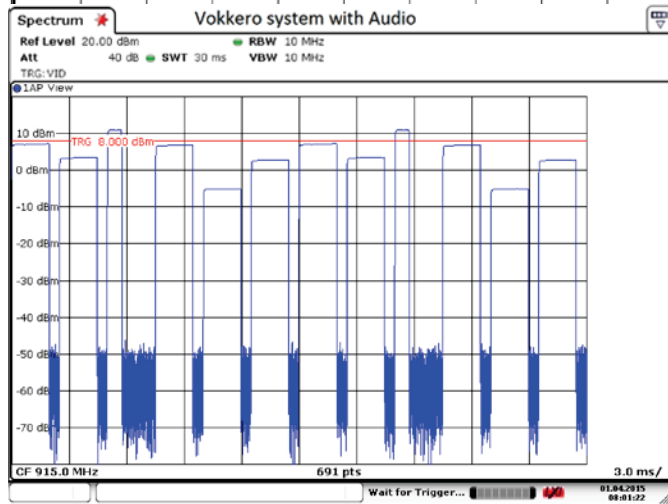
902-928MHz - Duty Cycle



US classic
=



Vokkero
>>

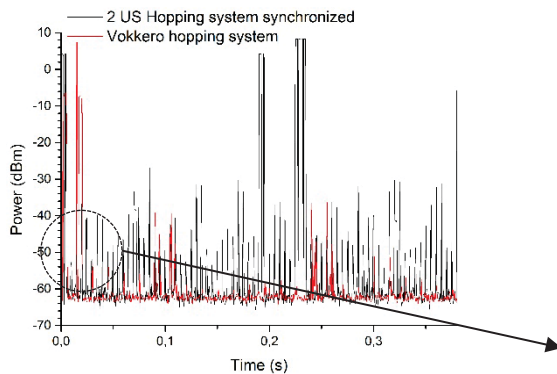


For all applications, limit the use of the spectrum at the minimum. Good engineering practices & more benefits for users.

Measurements made on real equipment

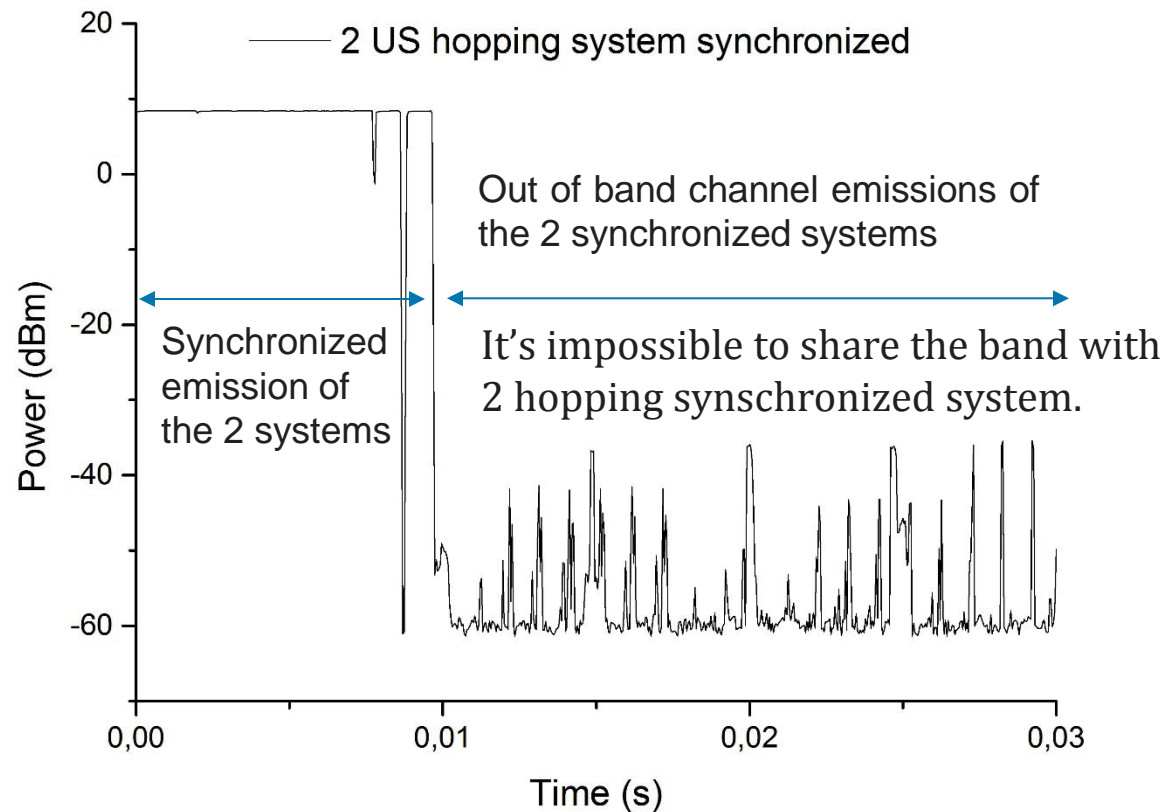
902-928MHz - Synchronization of Hopping systems

In some stadiums, we have observed that some hopping systems are synchronized with each other. This generates the following situation. Note channel occupancy vs time:



The law of one who shouts the loudest applies. Bad result!

In some stadiums, we find 4 hopping systems (2x2 synchronized) are being use just to create a 20 person radio system.



Measurements made on real equipment

902-928MHz – Synthesys option 1

To improve efficient use & sharing of the spectrum in the unlicensed 902-928 MHz band, Adeunis RF proposes changes for hopping spread spectrum systems set forth in sec. 15.247

- Forbid the synchronization of hopping systems in this band to allow other systems to co-exist in the same area.
- Limit the use of the spectrum to payload and avoid data padding (duty cycle)
- Implement requirements regarding modulation bandwidth and transient power.



902-928MHz – Synthesys option 2

To improve efficient use & sharing of the spectrum in the unlicensed 902-928 MHz band, Adeunis RF proposes to suppress the hopping requirement for wireless Microphone applications.

- This will allow systems to co-exist in the same area (At minimum 13 systems vs only 1 today)
- No modification for manufacturers (Only to fix the used channel)
- This could be limited to special event & program making.

NO Additional Cost



EASY TO IMPLEMENT



User Satisfaction

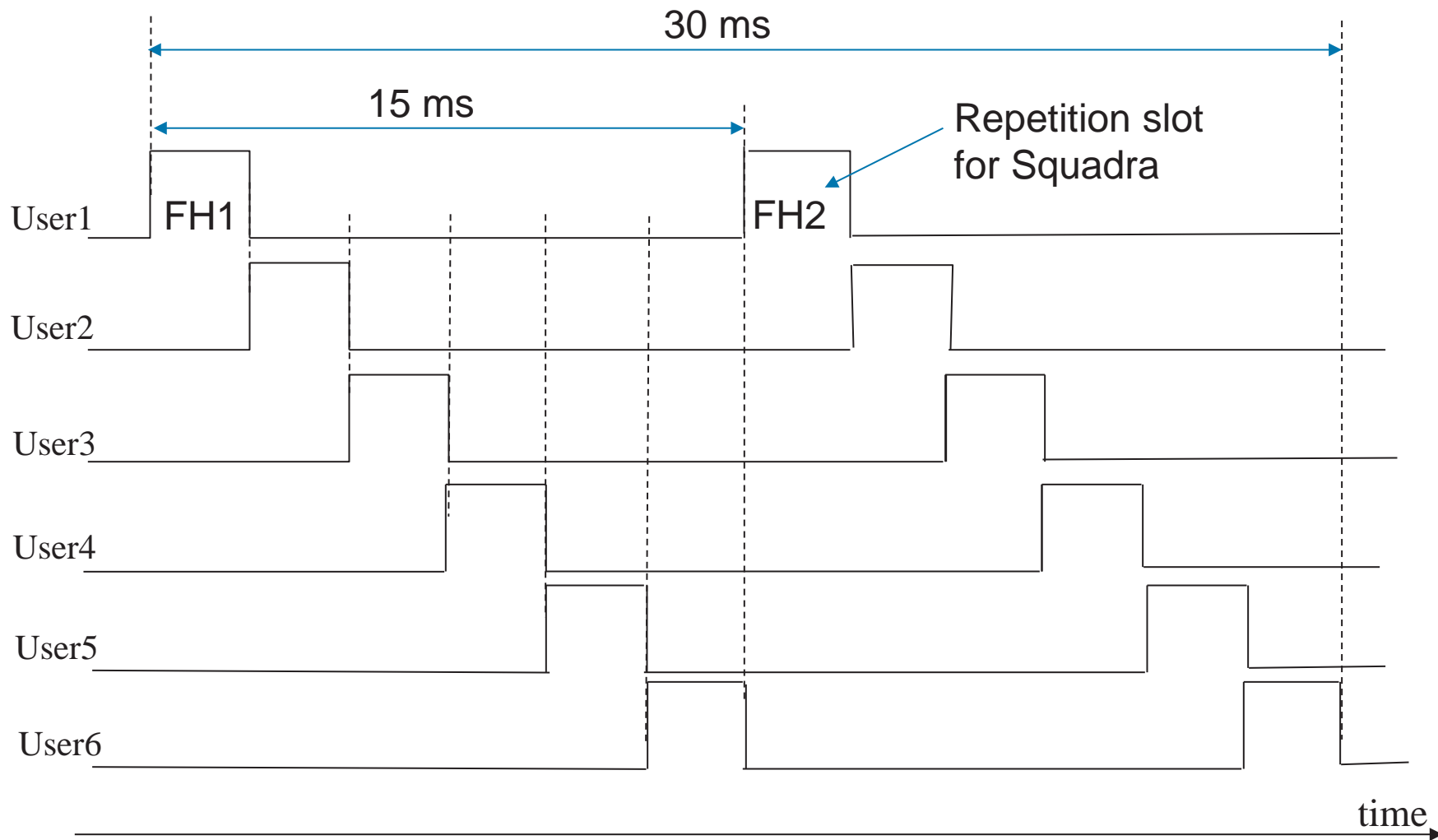


- It is critical to expand the 944-952 MHz band to be 941-960 MHz.
 - More flexibility for users and manufacturers alike.
 - Less interference for users & easy software updates for manufacturers.
- Modified LPAS rules, as proposed by Adeunis will provide protected communications & flexibility without additional regulatory burdens.
- Permit large venue operators with LPAS licenses to allow third-parties to operate low-power, wireless microphones under the large venue operator's license without further FCC approval
 - The license holder is motivated to coordinate usage without interference.
 - Third-parties are motivated to cooperate.
 - Negotiation and cooperation versus regulation.
- E.g., College or professional football stadium's license could cover TV, radio and cable broadcasters, home and visitor coaches, and game officials.



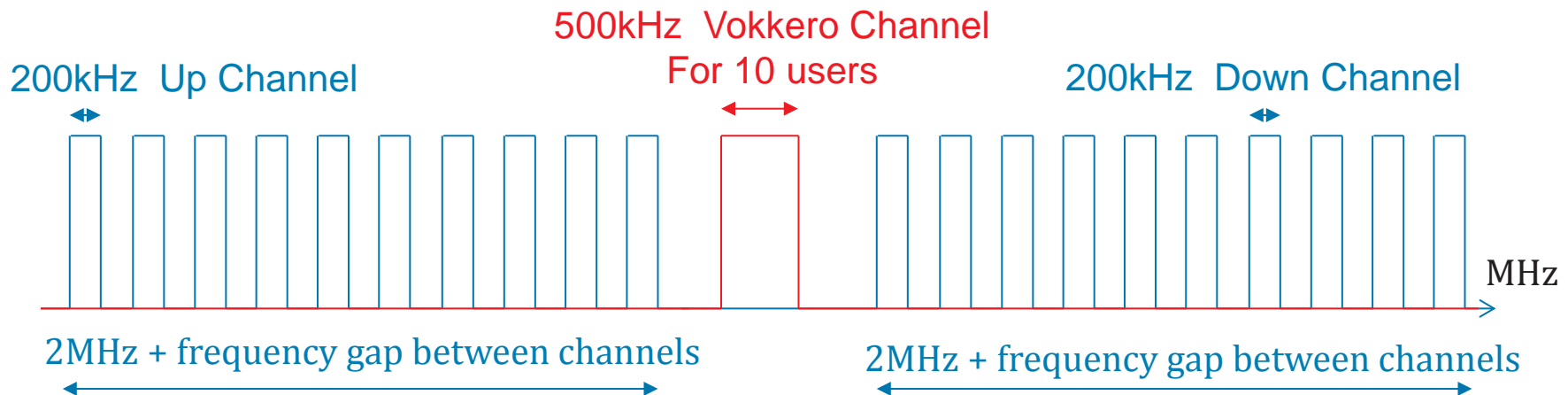
- TDMA is a well-established and successful way for users to share the same channel.
- For a classical wireless microphone application using belt packs and a base station the spectrum need is the following:
- For a 10 user system (For example, NFL team's coaching staff).
 - 10 belt packs
 - 2 channels per belt pack :
 - One 200 kHz Down Link channel (Base Station to Belt Pack)
 - One 200 kHz Up Link channel (Belt Pack to Base Station)
 - A total amount of spectrum equal to $10 \times 2 \times 200 \text{ kHz} = 4 \text{ MHz}$
- With a Vokkero TDMA system @230 kbps, we can answer the need with a single 500 kHz channel – Spectrum Efficiency.

TDMA & Hopping Scheme in a 6 users Squadra system



944-952 MHz - TDMA Technology

- Main advantages :
 - 500 kHz \ll 4 MHz
 - Easier to find a space of 500 kHz than 20 spaces of 200 kHz
 - No problem of adjacent channel selectivity



- Adeunis RF FCC to authorized 500 kHz channel bandwidth for system employing TDMA technology.
- This will permit a more efficient use of the spectrum.

Illustration based on real equipment

944-952 MHZ - Adding 941-944 MHz and 952-960 MHz Frequencies

- Adeunis RF support the transformation of the 944-952 MHz band to a 941-960 MHz band.
- This will allow more use of multiple radio systems in the location and facilitate spectrum sharing.
- The same product (hardware) will be able to cover all of the 941-960 MHz band and not just the unlicensed 902-928 MHz band.
- If extension is applied, two possibilities exist:
 - same technical requirements must be applied to the all 941-960 MHz band (19MHz frequency range)
 - or separate sub-bands may be used :
 - Analog and Digital systems.
 - TDMA and Non TDMA system.
 - Etc...

FH_n : Channel number **n** of the **F**requency **H**opping sequence

FHSS : **F**requency **H**opping **S**pread **S**pectrum according FCC part 15.247

GFSK : **G**aussian **F**requency **S**hift **K**eying

LPAS : **L**ow **P**ower **A**uxiliary **S**tations

RBW : **R**esolution **B**and **W**idth of the spectrum analyzer

Rx : **R**eceiver

TDMA : **T**ime **D**ivision **M**ultiple **A**ccess. Method using time slots to share a channel between different users on the same channel.

Tx : **T**ransmitter

Q & A

